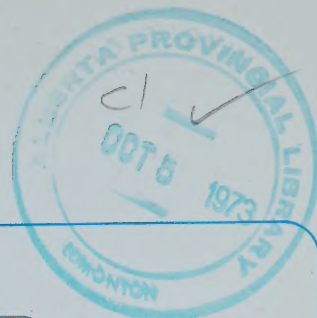


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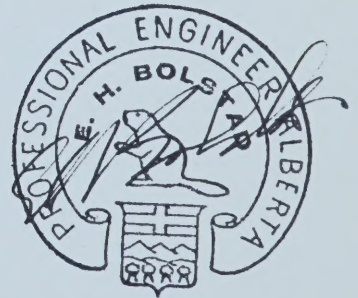
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SUMMARY REPORT
ON
THE EDMONTON NOISE SURVEY

Commissioned by:
THE HONOURABLE W.J. YURKO, MINISTER
ALBERTA DEPARTMENT OF THE ENVIRONMENT

Prepared by:
BOLSTAD ENGINEERING ASSOCIATES LTD.
EDMONTON



March, 1973

NOTE

This Summary Report is based on the Technical Report of the Edmonton Noise Survey. Copies of the full report plus the Technical Appendix are available from The Alberta Department of the Environment.



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I N T R O D U C T I O N

In December, 1971 the Department of the Environment, Province of Alberta, authorized a noise survey in the City of Edmonton to determine existing levels of noise and citizens reaction to that noise and to identify the principle sources and possible remedies. The program was carried out by Bolstad Engineering Associates Ltd during the summer and fall of 1972. This report summarizes the results and points out significant problems and possible solutions. A more complete technical discussion of the sampling methods and the data obtained is contained in a separate Technical Report on The Edmonton Noise Survey and Appendix to the Technical Report.

Since this volume is intended to be read by many persons who have little or no technical knowledge of the subject, a short discussion on noise measurement, its effects on people, and the methods used for expressing the results of the survey has been included. The technically sophisticated reader can of course skip by these portions.

NOISE - PHYSICS AND PHYSIOLOGY

NOISE & HEALTH

Although noise has been with us for many years it is only recently that it has been recognized as a pollutant in the environment. This is probably because noise levels have been very gradually increasing over the years along with the ever increasing mechanization and industrialization of our society.

The World Health Organization defines health as "a state of complete physical, mental and social well-being, and not merely an absence of disease and infirmity." In this very general context, noise must be considered as a pollutant if it affects the health of the individual. This is particularly true if it causes annoyance, interferes with sleep, impairs speech communication, interferes with working efficiency, or poses a damage risk to hearing.

The public reaction to noise is a very complex matter which depends on a variety of physiological, psychological and sociological factors. Knowledge of the correlation between subjective reaction to noise and physical measurement of noise is not by any means complete, but the state of the art is continually advancing and a large pool of knowledge is available on the physical attributes of sound and noise.

FUNDAMENTALS OF SOUND

In general, "noise" refers to unwanted sound although, in a few rare cases, noise can be considered as wanted sound in a very quiet environment.

Sound, in scientific phraseology, is a type of wave motion which can exist in a solid, liquid or gas. What finally reaches our ears is a sound wave travelling through air.

A sound wave in air consists of small fluctuations in air pressure superimposed upon the atmospheric pressure. It is these very small fluctuations that are detected by the ear as well as by a microphone.

A continuous pure tone sound has associated with it a characteristic called frequency (usually expressed in cycles per second or more recently in Hertz.) Frequency corresponds to our idea of pitch.

A low pitched bass singer will emit notes with a fundamental frequency as low as 60 to 80 Hertz. A soprano will reach fundamental frequencies as high as 1200 Hertz. The characteristics distinguishing one voice from another or one noise from another are given by superimposing much higher frequencies (overtones) on the fundamentals.

Persons with excellent hearing should be able to hear sounds from 20 to 20,000 cycles per second. Speech sounds generally fall in the range between 100 and 4,000 cycles per second. Of course, a complex sound like traffic noise can contain any mixture of frequencies -low and high. Sounds containing equal amounts of all frequencies are termed white noise, much like white light which contains all frequencies in the visible light spectrum.

Some sounds are louder than others. This characteristic of sound is described by the term amplitude, or sound level. It is easier to talk about amplitude if one has a standard reference. Such a reference has been internationally adopted and corresponds to the sound pressure for barely audible sound in a controlled laboratory environment. Sounds that we hear every day may be anywhere from a thousand to a million times as great as this reference pressure.

THE DECIBEL - WHAT IS IT?

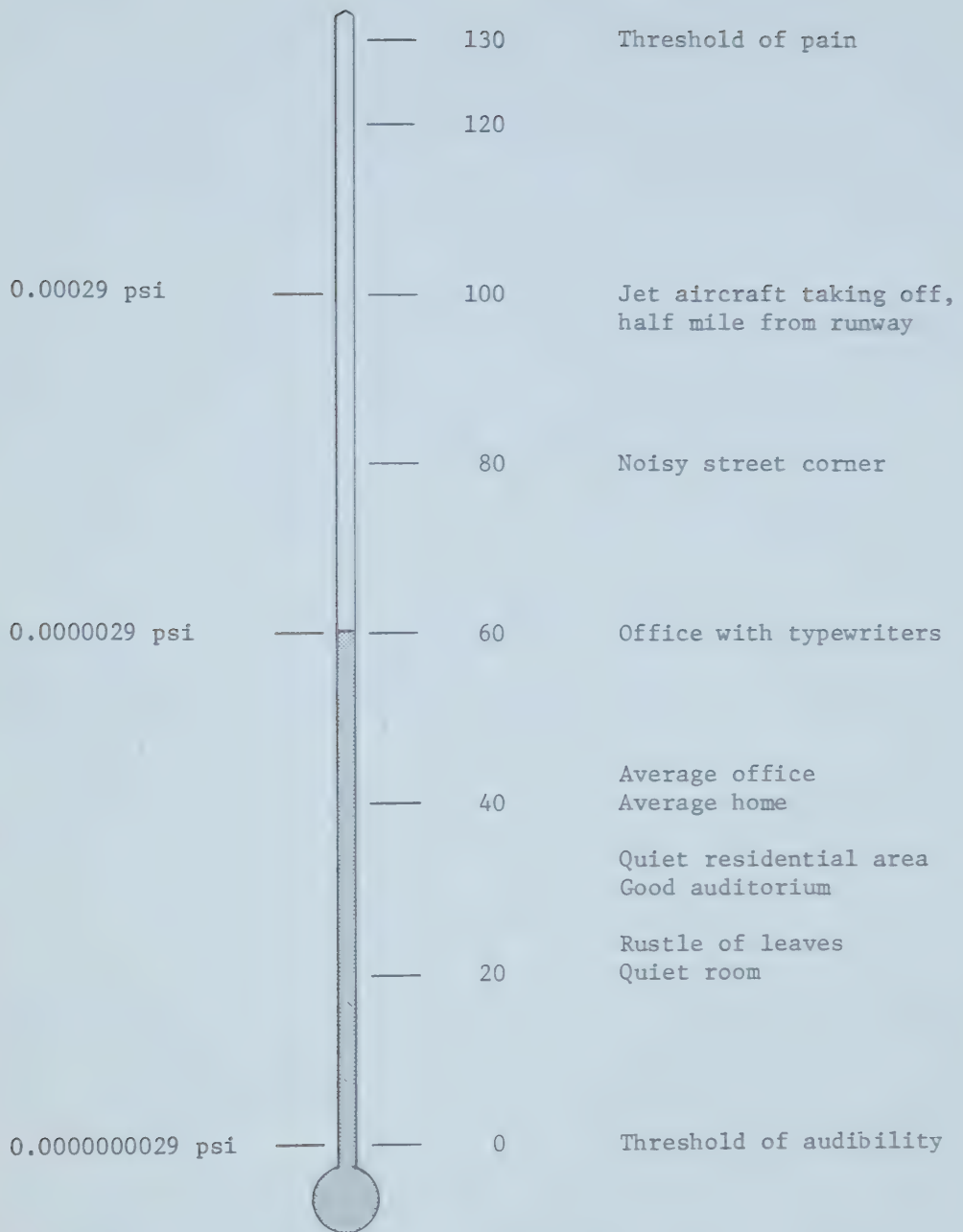
Because of this extreme range, and to make calculations easier and more meaningful, the ratio between any particular sound pressure and the reference pressure is expressed in terms of its logarithm and the term is called a decibel (dB.) Thus, the sound pressure level in decibels, corresponding to a sound pressure P is given by the formula:

$$20 \log \left(\frac{P}{P_0} \right)$$

In this formula P_0 is the standard reference pressure of 0.0002 microbars (approximately the minimum level of audible sound.)

The use of dB to describe a sound pressure is similar to the use of degrees of temperature to describe how warm something is in comparison to a reference level (melting ice.) It is also worth noting that the human ear discriminates sound level in an approximate logarithmic manner.

The decibel scale can be further illustrated by means of a "noise thermometer" shown on the next page. This serves to delineate sound intensities throughout the hearing range, from just audible to those on the threshold of pain. To illustrate the order of magnitude of the pressures involved, the equivalent values in pounds per square inch are noted beside the decibel levels.



TYPICAL SOUND PRESSURE LEVELS, dBA

THE SOUND LEVEL METER vs THE HUMAN EAR

The response of the human ear to sound can be somewhat complicated. So far, it has been discussed that the ear can detect frequency and level. It is also known that the ear's sensitivity to frequency varies with level; at low pressure levels, the ear is rather insensitive to low frequencies, at high pressure levels, the ear is almost equally sensitive to all audible frequencies.

The sound level meter, unlike the human ear, responds equally to all audible frequencies at all pressures. In order to make it respond in a manner similar to the human ear it is necessary to introduce electronic filters or "weighting scales" into the instrument. The most common ones have been standardized by international agreement as "A", "B" and "C". The "A" scale suppresses frequencies in increasing amounts below 500 hertz and approximates equal loudness contours for the medium pressure range. The "C" scale only suppresses a small amount and approximates human response to the high sound levels. Of course, the "B" scale lies in between the two.

It has been found that on the average, people's reaction to noise is most consistent with the "A" scale values, particularly for noises commonly found in a mixed noise environment. For this reason it is common throughout most of the world to make simple noise measurements on the "A" scale. It is also significant that most noise bylaws are enforced by dBA readings*

* Bylaw No. 3030 "A Bylaw to Prohibit, Eliminate or Abate Noise Within the City of Edmonton "

EFFECTS OF NOISE ON PEOPLE

Noise can affect people in a variety of ways. Lack of noise or complete silence can not be tolerated by most individuals for very long. This however occurs rarely in our present way of life. High noise levels can damage our hearing permanently. In the middle region noise impairs speech intelligibility and can at times be considered a nuisance or annoyance.

Individual noises become noticeable once they rear their head above the prevailing ambient level. The same noise could be disturbing to one person and neutral to another; whether a particular noise is annoying is a subject in itself and there is no simple rule that will predict the effect on any one person.

There are certain characteristics of noise that are definitely considered to contribute to annoyance. In fact, there can be instances in which the regular "A" scale readings will be quite misleading. These involve noise conditions characterized by intermittency warbling of amplitude or frequency, impulse effects, tonal effects, and predominance of high frequencies.

Very high noise levels can cause irreversible damage to our hearing ability. There is a wealth of information available on this subject but the consensus is that the probability of hearing damage depends on the combination of both exposure time to the noise and the sound level present. Allowable noise exposures are defined in Alberta by provincial health regulations*. The permissible noise exposure for an eight hour working day is 90dBA or less. More severe noise levels are allowable only if the corresponding daily exposure is reduced.

* Provincial Board of Health Regulations respecting the protection of workers from the effects of noise 1971 - The Public Health Act, Section 7 (1).

THE EDMONTON NOISE SURVEY

THE AIMS OF THE SURVEY

The terms of reference of the Edmonton Noise Survey as set forth by the Department of the Environment included the determination of the level of noise occurring in representative areas of the city, the determination of areas in the city in which significant or critical noise levels are occurring, and the associated source of the predominant noise. In addition, the survey was to determine the reaction of citizens to the noise.

THE NOISE CLIMATE

The situation with regard to sound and noise in a city is a dynamic one. In this respect, our sound environment is not unlike that of our weather. Variables such as temperature, wind strength, precipitation and humidity can be used to describe the changes in weather. These changes, when measured over extended periods of time can be called "climate." In a similar fashion, the regular observation of variables describing noise can provide an understanding of the "noise climate" of an urban environment.

Some of the features of the noise climate are thought of as undesirable and have been labelled "pollution". Remedial measures to reduce such "pollution" require first, a clear understanding of the climate which prevails within the urban setting. Not all noise is undesirable. It would be strange if a crowd did not make noise at a football or a hockey game. A quiet New Year's Eve party would generally be considered a failure. A certain amount of noise associated with pleasure and business activity is stimulating. The real problem is to determine what is acceptable and what is not, and, like the weather, what can be done about it.

THE SAMPLING PROCEDURE

A complete and detailed collection of the noise levels from all areas of the city would involve continuous 24-hour sampling and analysis of noise at hundreds of locations. Such a procedure requires much equipment and manpower and would be extremely costly. The technique then, must involve the selection of representative locations which will give a good evaluation of the noise climate at all locations and the selection of a time sampling method which will similarly give a good evaluation of the noise occurring throughout the day at the chosen locations.

Two approaches were considered for sampling procedures. The grid system, often used in surveys, involves the division of the area of the city into equal sub-units by mere imposition of a set of grid lines on a map. This is a reasonable approach provided the city is reasonably homogeneous in terms of land use, distribution of population, etc. The other approach considered was the use of representative cells. A cell was defined as a region bounded by any of the following: truck route, arterial roadway, first class collector roadway, river, ravine, etc. It was felt that Edmonton could best be sampled on the basis of representative cells as the city was not sufficiently homogeneous to satisfy a grid approach.

Representative residential cells were selected according to those criteria likely to be related to noise annoyance. To simplify matters it was assumed that noise levels and/or people's response to noise would depend primarily on these variables:

- Density (people per acre)
- Number of people per cell (size of cell)
- Traffic flow (vehicles per day along cell perimeter)

As a consequence, the Edmonton City Zoning Map was broken down into a total of 217 residential cells, some commercial and some industrial cells. The residential cells were further classified according to the distribution of values for the above three variables. Three levels (low, medium and high) of each variable resulted in a system having 27 mutually exclusive categories. Every residential cell could therefore be classified as one of these 27 categories.

It should be noted that this is an artificial procedure for generating representative areas. It is quite possible that more parameters could be involved or that the three parameters chosen may not be equal in importance. To make the chosen cell in each category even more representative, the final selection took into account geographical location and proximity to industrial operations. Visual inspection of the representative cells chosen indicated that the City of Edmonton would be sampled quite adequately.

Figure 1 presents a listing of the representative cells chosen together with some of their relevant characteristics. A total of 39 cells is given of which 31 were sampled for noise levels, and 37 were canvassed for subjective opinions.

Since it is a very expensive process to record and analyze the noise continuously, it is necessary to use a time sampling technique which will give results close to the values which would come from continuous recording.

There are several ways in which this time sampling can be conducted, but in principle the best accuracy can be obtained by taking very short samples frequently. It can be likened to the taking of a time lapse motion picture, which uses a series of very short still pictures projected at a higher speed to simulate the entire day in the space of perhaps one to one and a half hours.

In this survey it was decided to use 15 second samples taken every 4 minutes which gave approximately 90 minutes of recording for each 24 hour period. This utilized the capacity of a standard reel of tape which was changed once each day.

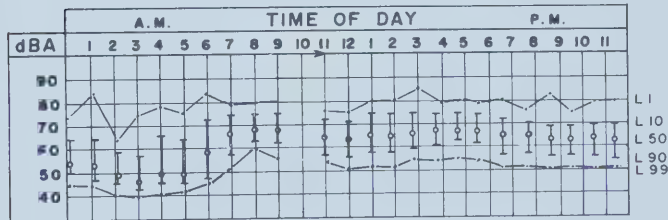
The accuracy of the method is very good for sampling traffic and other noises which generally rise and fall in a gradual manner. It is not good for loud noises which are of very short duration and infrequent, such as those related to the aircraft movements at the Industrial Airport. As noted in later discussions, a different sampling technique was used for that study.

DATA GATHERING

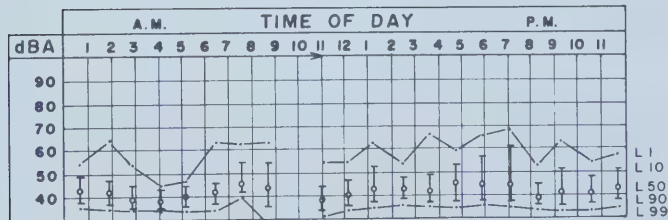
Data for the objective noise survey was gathered from May to December, 1972 with the bulk of the noise recordings obtained during the summer months. 136 locations in 31 representative cells were sampled for noise levels during the weekday. A small number of locations were also sampled during the weekend, as well as some downtown locations and a rural area just outside the city limits. Special attention was focussed on two unique areas within the city namely, the Canadian National Railways Humpyard and the Industrial Airport. The listing of representative cells sampled and their community names is shown in Figure 1. Cell locations are depicted on the map of Edmonton enclosed at the end of this report.

DATA PRESENTATION

The noise data was plotted out as L10, L50 and L90 levels (dBA levels exceeded 10%, 50% and 90% of the time) for each hour of the day for each test location. As shown on the accompanying diagrams, this presentation depicts visually the rise and fall of the noise "floor" and the variability of the noise through the day. While the values for L1 (1% level) are not entirely reliable due to the microsampling technique, they are shown here for interest. The L99 levels have also been shown here for interest although they are not shown on the bulk of the data sheets since they follow the L90 levels very closely and do not represent a significant difference from the generally accepted L90 noise "floor."

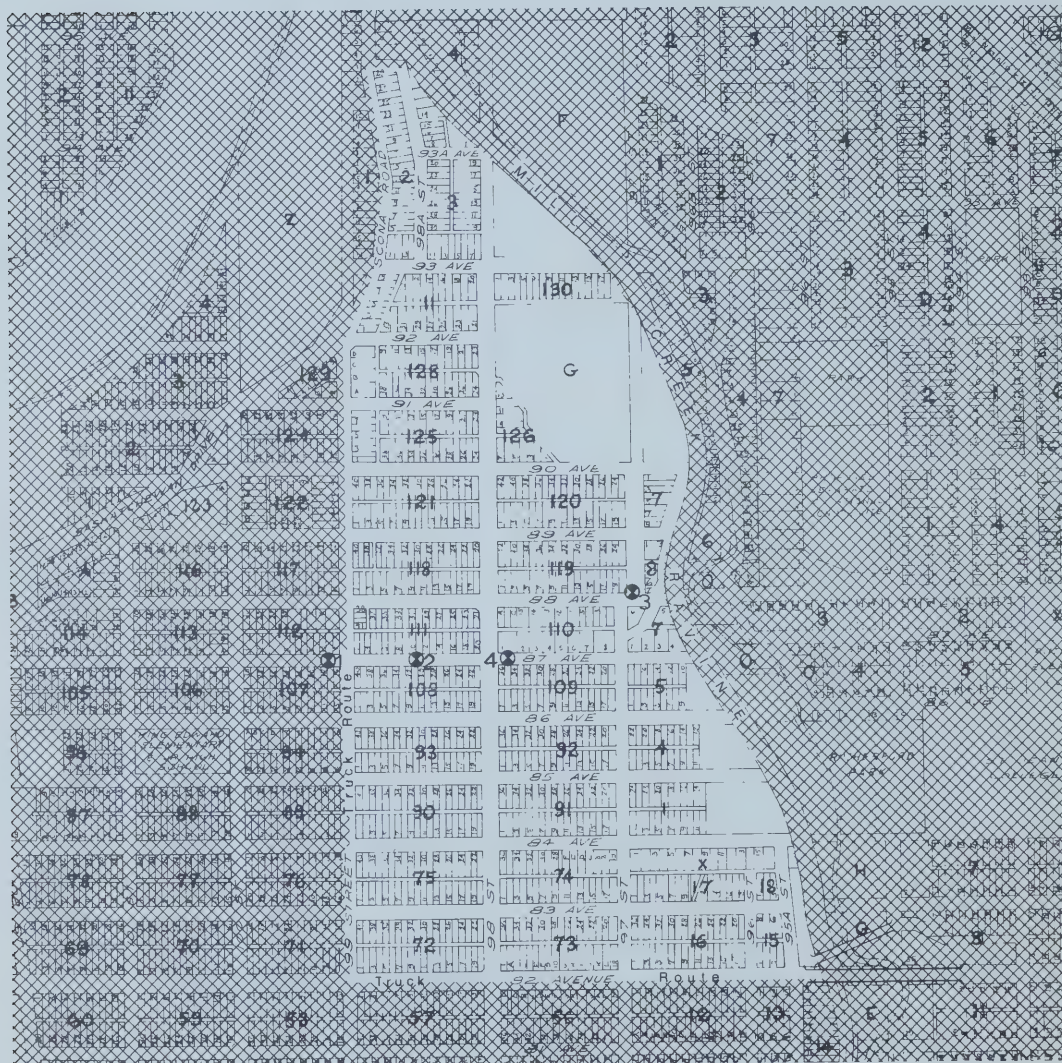


Rc 38-1; MONDAY, MAY 8, 1972; 36 FEET WEST OF TRUCK ROUTE ALONG 99 STREET; AT INTERSECTION OF 87 AVE. AND 99 STREET.



Rc 38-3; TUESDAY, JUNE 27, 1972; TWO BLOCKS EAST OF 99 STREET AND NEAR MILL CREEK RAVINE

As an example of the procedure, in the cell designated Rc-38, shown on the small section map below, four points sampled. Location No. 1 was close to a truck route; No. 2 was 1/2 block away from a truck route; No. 3 was at the back of the cell, adjacent to a large ravine park; and No. 4 was in the approximate mid position. The results of tests 1 and 3 show clearly the effect of traffic and local noise.



In Test No. 1, the L90 level was comparatively low from midnite to 6 A.M., with occasional heavy vehicle passage raising the L10 level to values between 58 and 65, and L1 levels from 72 to 82, a most unsatisfactory situation for sleeping in nearby residences. As the traffic picked up after 6 A.M. the L90 levels rise sharply to values between 56 and 62. Note that the L10 levels also rise, but the spread between L10 and L90 is significantly less.

In Test No. 3, the L90 level is low all day, indicating a very quiet neighborhood. The L10 level is low all night long, and rises during the day to reflect some local traffic and in particular some backyard construction activity in the early evening. Even the L1 levels do not reach significantly high values.

Noise graphs of the locations selected indicate that noise levels are generally at a maximum during the day and lower at night, although for a relatively small number of hours. The noisiest part of the 24 hour day is sometimes designated "acoustic day" and the quietest part as "acoustic night." It appears that in Edmonton, acoustic day starts at about 7 A.M. and continues to about 12 P.M., with acoustic night in the remaining time. A few typical instances are: 87th Avenue & 99th Street; 82nd Avenue & 97th Street, 79th Avenue & 98th Street; 96th Avenue and Ottewell Road.

There are, however, locations in Edmonton where noise levels are fairly constant throughout the day. Some of these are: 79th Avenue & 96th Street; 70th Avenue & 91st Street; 103rd Avenue & 70th Street; 104th Avenue & 42nd Street; 104th Avenue & 36th Street; 108th Avenue & 30th Street. Further examination of these communities reveals that fairly constant quiet conditions were found in the centre of residential cells far removed from major traffic routes. On the other hand, constantly noisy conditions prevailed if some industrial process was nearby, e.g. meat packing plant, refinery or railway.

The full complement of data is presented in the Technical Report and Appendix to the Technical Report, separate volumes.

DATA INTERPRETATION

A simple way of assessing the noisiness of a location is by means of the 24 hour average of L90, L50 and L10 levels. This has been calculated for all locations and is depicted in Figure 2. A more complete analysis would involve the incorporation of the (L10-L90) spread into the much debated Traffic Noise Index. From this simple calculation, a fair sampling was obtained of locations with high noise conditions. These locations include:

along 99th Street	Rc-38
along 82nd Avenue	Rc-39, Rb-82 Rd-10, Rd- 7
along Argyll Road	Rb-86
along 98th Avenue	Rb-72
along 118th Avenue	Rc-28, Rc-23, Rc-15, Rb-49
along Jasper Avenue	Rd-20, Rd- 1 Downtown 1
along 127th Avenue	Rd-17
along 127th Street	Rd-17, Rb-97
along 137th Avenue	Rb-97
along 142nd Street	Rb-49
along 125th Avenue	Rb-49
along 102nd Avenue	Rb-33
along 156th Street	Rb-106 Rb-30
along 107th Avenue	Rb-106
along 149th Street	Rb-106 Rb-46
along 87th Avenue	Rd-10

These particular locations are characterized by average "acoustic day" L10 levels of 70dBA or more - as a matter of fact they correspond to 24 hour average L10 levels of 67dBA or more. It is noteworthy that these locations are situated along typical residence lines near truck routes carrying 10,000 or more vehicles per day and arterial roads carrying 12,800 or more vehicles per day.

In very general terms information based solely on noise level versus traffic flow can be extended to the remaining roadways in Edmonton. It would not be unreasonable to conclude that any truck routes with at least 10,000 vehicles per day or arteries with at least 15,000 vehicles per day would result in a high noise condition with L10 levels of 70dBA occurring in daytime. Furthermore, there is a sufficient amount of evidence to indicate that areas with L10 levels of 70dBA or more are unacceptable for residential use.

Beside the actual level of noise itself it is also known that the amount of fluctuation or spread of the noise contributes to annoyance. In our case, the spread of noise can be most easily associated with the difference of upper and lower decile dBA levels, i.e. (L10-L90). 99th Street and 87th Avenue, 82nd Avenue and 97th Street, 96th Street and 72nd Avenue, 83rd Street and 73rd Avenue are locations with high spread. Some locations with a low spread are; 96th Street and 79th Avenue, 70th Avenue and 92nd Street, 70th Street and 103rd Avenue, 97th Avenue and Riverside Drive. Average spread over a day has been determined for each location and is documented in Figure 2.

Locations with high noise spread were found most often near heavy truck routes as well as collector roads through a fairly quiet residential sector. Low noise spread prevailed in the quiet interior of low density residential cells; it was also observed in areas affected by constant noise output from industrial operations.

Noise levels in the interior of most community cells appear to be low and compare favourably with similar locations in cities of this size. Many cell interiors have a noise envelope of L90 of from 30dBA to 40dBA. Low noise envelopes prevailed over 24 hours at the following points: 88th Avenue and 97th Street (37dBA), 103rd Avenue and 70th Street, (38dBA), Fulton Road and 56th Street (38dBA), 104th Avenue and 36th Street, (36dBA), 120th Avenue and 58th Street (34dBA).

In most cases cell interiors were subjected to a noise "floor" of between 40 and 45dBA, i.e. 87th Avenue and 98th Street (45dBA), 79th Avenue and 98th Street (42dBA), 72nd Avenue and 94th Street (43dBA), 57th Avenue and 114th Street (43dBA).

It was not surprising to find a high noise envelope well above 50dBA right in the downtown business district (See Downtown 1 and 2.) It would appear that the noise envelope in a cell interior would depend on the following:

- distance to major roadways
- distance from edge of city
- proximity of industrial operations

The majority of noise measurements were carried out on weekdays with a small number carried out on the weekend, from Saturday morning to Sunday morning. Comparison of Friday and Saturday readings indicate only small differences in the overall averages. Minor variations include reduced noise on a 40mph truck route (Argyll Road) and increased noise on a 30mph truck route (82nd Avenue). These results probably reflect a variation in both vehicle mix and traffic flow from weekday to weekend.

THE AIRPORT

Additional noise measurements were carried out in the vicinity of the Edmonton Industrial Airport. As the microsampling technique loses accuracy in reporting the influence of isolated short term events, it was considered prudent to supplement these recordings with data peculiar to aircraft activity. Consequently, peak dBA levels were obtained for all aircraft taking off from the airport in a typical weekday. The data obtained was actually spread out over three days and under the flight paths of the three most commonly used runways. The location of the noise measuring points are shown on Figure 4. The data obtained is shown in Figure 3, plotted together with the estimated noise envelope (L90) at the test location. The diagram gives a good indication the amount of aircraft noise intrusion and its occurrences.

The locations under takeoff flight patterns are exposed to 100dBA levels from large jet aircraft and 60 to 90 dBA for the majority of propeller-driven aircraft. The jet aircraft were characterized by a fairly random noise spectrum and short passover time whereas propeller-driven aircraft were tonal in character and much more extended in passage time. Propeller-driven aircraft activity was much greater, sometimes every minute or two, in contrast to the low frequency activity of jet aircraft.

THE RAILWAY

Another area given special attention was the residential sector just north and south of the Canadian National Railways Humpyard on 127th Avenue. Vigorous complaints of residents during midsummer prompted the tests. Micro-sampling of the area indicated that the L90 noise envelope averaged between 40 and 50 dBA with the lower value at night. Also indicated was that noise from humping operations was fairly constant day and night.

Sorting train cars by means of a humpyard involves diesel engine noise, retarder squeal, compressed air noise for braking and box car banging. These operations became most noticeable in the evening hours when ambient levels from other sources such as vehicular traffic flow and aircraft activity at the nearby Municipal Airport were reduced. One of the most obnoxious noises was the brake squeal from master and inert retarders slowing box cars—a wavering pure tone-like sound of about 2000 Hertz and ranging from 60 to 80dBA. The number of occurrences and the loudness was generally much less than that coming from aircraft and often the level was no greater than the ambient noise, but it could still be identified.

HOW DOES EDMONTON COMPARE?

No direct comparison has been made between the results for Edmonton and other cities, partly because the results of other surveys have been presented in a variety of ways which preclude direct comparison. Some general observations are however possible.

The noise survey conducted in Vancouver, B. C., in 1971 showed overall nighttime L90 levels of 35dBA and L10 levels of 55dBA. This would of course include higher and lower levels in different districts, but it compares favourably with nighttime L90 levels in Edmonton from 34 to 40dBA and L10 levels of 56 to 60dBA. In the daytime in Vancouver, these levels rise about 7 to 9 dBA, consistent with the results in Edmonton. Most noticeably, the high levels recorded along the periphery of many Edmonton residential areas almost equals the average levels for commercial districts in Vancouver.

COMMUNITY RESPONSE SURVEY TECHNIQUE

To assess the variables involved in community reaction to noise pollution, it was necessary to consider a number of measurement techniques.

A widely used procedure is the standardized interview of individuals. This is accomplished by trained interviewers, using a structured interview schedule, who sample households and locations to obtain representative evidence concerning the problem. The advantage of the structured technique is that it makes possible the comparison of responses across people, locations and occasions.

Another procedure is the self-administering test conducted with paper and pencil only. This is an alternative method to the standard interview and can be used to elicit a response from individuals that are busy or not at home during the day.

In these type of measurement techniques it has been observed that respondents tend to exaggerate complaints about noise if they perceive that the results of the interview will influence government action. Hence the structure of the interview must be such as to avoid leading or biased questions.

Other techniques involve indirect measurements which do not involve solicited responses of specific individuals. These include press coverage on noise, letters to the editor, and written or telephone complaints to municipal agencies. These latter data are less easily interpreted than the first two but are important as additional information.

The Edmonton Noise Survey was conducted by utilizing the standard interview and the self-administering questionnaire, supplemented by unsolicited recorded complaints.

Direct interviews took about 15 minutes. The interview dealt initially with general living conditions in the area and then moved on to more specific problems of noise. The extent to which noise caused sleep disturbances and respondent's awareness of potential remedial action were two major concerns of the remaining topics.

At the same time as the direct interviews were being carried out, some residents were asked to complete a self-administered questionnaire. There were several reasons for its inclusion. First, a great number and a greater variety of respondents could be sampled in this way. Second, although the questionnaire had questions in common with the interview, it had a different aim, to assess quickly the annoyance of particular types of noises.

The subjective survey was handled by four interviewers, three female and one male. (They were hired as temporary staff for this project on the basis of some university training in the social sciences.) These students were well qualified for this project and had attended the university from two to four years.

RESULTS OF COMMUNITY RESPONSE SURVEY

Altogether there were 3,013 self-administered questionnaires completed and 1,201 personal interviews carried out. Results for a number of variables can be gleaned from these data. It is clear, however, that the potential number of these variables is extremely high. Some of the major ones have been analyzed and are reported here with comment. The raw data are to be retained and subsequent, more detailed analyses are of course possible.

Figure 5 shows the results of selected variables compared between areas of the city. It is of interest to note that traffic noise, air pollution and dangerous traffic are the most disliked features over all areas. The major problem is not necessarily noise, however. In addition, although perceived noisiness varies between areas, it is not related to traffic density or to measured levels.

It is assumed by many that all noises create a problem. The survey revealed otherwise. There were more than a few cases where subjects did not complain about noise in very noisy areas. An example of this is the Queens Avenue area. Queens Avenue is bordered by three truck routes and an arterial road. It is also close to the downtown area. Yet it was surprising how many subjects did not object to noise or declined to complain. It seemed that many elderly people in the area had become accustomed to the noise over the years or perhaps were simply hard of hearing.

Whereas it was found that some subjects did not complain of noise in very noisy areas, it was also found that some complained excessively about the same problem in quieter areas. Aside from eccentric responses which were found in all areas of the city, the magnitude of complaints about all neighborhood problems (not just noise) seemed to be greater than the actual problems in South Garneau, an area adjacent to the University of Alberta heavily populated by University students and staff. A plausible explanation of this phenomenon could be made in terms of the increased articulateness and verbal abilities of these residents as well as a greater awareness of political and social problems and means for their solution. These personal resources thereby predisposed them to complain excessively.

The greatest variation of any dimension of the study was found in the different types of noises encountered or complained about.

The most frequent noise complaint was about traffic. Traffic noises were most bothersome where houses and apartments were directly on an artery or truck route. This rule applied regardless of the area. As dwellings were located further from major traffic routes, the noise decreased rapidly. For example, whereas traffic noise was a serious problem along 75th Street immediately south of the Capilano Freeway, complaints were moderate one block east and infrequent two blocks east. Therefore the problem of traffic noise was greatest wherever dwellings were located on or very close to major traffic routes, and there were no areas where traffic noise was a problem throughout with the exception of downtown areas characterized by a constant stream of heavy traffic.

A special complaint which would come under the heading "traffic noise" was with motorcycles and "teenage driving." The latter term refers to complaints about youth who unnecessarily and deliberately create noise by speeding, squealing tires or "drag racing", particularly at night. Many sleep disturbances that were reported were due to this noise. This problem was found in nearly all areas of the city, but was less in developments such as Greenfield which were designed with numerous crescents and bending roads discouraging speeding cars.

Aircraft noise was the second most frequent noise complaint. Unlike traffic noise, aircraft noise complaints were localized to specific areas—those immediately surrounding the Industrial Airport and along aircraft take off and landing routes. Complaints were heavy in all areas south of the airport to the city boundary where aircraft routed between the Industrial and the International Airport, and Edmonton and Calgary fly. An interesting dimension to the aircraft complaints were the surprising lack of serious complaints about single engine craft which fly above Calder Elm Park north of the Industrial Airport. Residents here regarded the small aircraft as "pesky" but of no major concern. Serious annoyance with aircraft was expressed in Oliver and South Garneau, however.

A third serious noise complaint was registered against railway noises. Interviewing was conducted in Calder during the midst of a crisis surrounding the CN Calder Humpyard. Residents here were alarmed over the squealing noises from the humpyard, although they regarded aircraft noise as the more serious problem. Another area where numerous complaints about railway noises were made was in Strathcona through which the Canadian Pacific's line ran. Complaints here were made against the clanging of train bells.

Less frequent complaints were made about a variety of miscellaneous noises. Noisy neighbors were an occasional problem in nearly every neighborhood as were barking dogs and fighting cats. Also mentioned were fire engine and ambulance sirens, most frequently in the downtown area and near hospitals and fire stations. Once in a while subjects complained about noisy buses, some so noisy that they would shake a house when they went by. An infrequently heard noise was from industries, probably because most are well removed from residential areas. But although industrial noises did not carry far, residents could not escape their prevalent odours.

Of the general problems mentioned by residents during the survey, noise was probably the one mentioned most frequently. A second problem of great seriousness was odours. A vast part of eastern Edmonton is victim of the refineries along "Chemical Row." These odours extend beyond 132nd Avenue on the north, to 90th Avenue on the south, and 60th Street on the west. The eastern part of the city is also subjected to the odours from Gainers, Swifts and Burns meat packing plants. Gainers on 96th Street near 82nd Avenue emits a smell that is frequently described as nauseating. Swifts and nearby Burns make life unpleasant for residents of western Newton.

A curious reaction that is worth mentioning here was observed when subjects were asked if they found their area unsafe to walk in at night. Many females responded by saying that they didn't know if it was unsafe because they never walked alone at night. When asked why they didn't they could not give an adequate answer. Many women who responded that it was unsafe qualified their response by stating that it is unsafe to walk at night anywhere in Edmonton or any large city. This general condition inhibited them from voicing their problem, although it did not genuinely allay their fears.

CONCLUSIONS

As could have been expected, the major finding of the survey is that noise from vehicular traffic is of greatest concern to citizens. It has not yet been established what numbers of people are subject to any given levels of noise but it is considered that there are sufficient numbers in the vicinity of the major truck routes and arterial roads to be serious. Of secondary concern to citizens was aircraft noise in the vicinity of the Industrial Airport and associated flight paths. There were a variety of other noise nuisances mentioned by residents but no clear majority reported any particular noise source.

The obvious conclusion that one must draw from the data is that heavy traffic, which grows in volume every year, has been permitted to encroach far too heavily on residential areas - or conversely, residential areas have been permitted to develop too closely to traffic arteries, railroads and industrial areas without the requirement of special construction or barriers to offset the problem.

Since much of the problem stems from the placement of roads and residences, it is likely that little can be done to alleviate the existing situation without considerable expense. Recommendations can, however, be given to control noise in redevelopment and new development areas. These are:

- ° reassessment of zoning in the vicinity of major truck routes and arterial roadways
- ° use of barriers, berms and buffer zones between heavy traffic areas and residential zoned areas
- ° modification to building code for sound proofing of structures where ambient noise is not practical to control otherwise
- ° analysis of transportation systems likely to reduce noise impact on the urban community as a whole e.g. freeways, rapid transit
- ° reassessment of noise levels permitted by local noise bylaw and possibility of progressive limitation of noise levels from certain classes of vehicles, industrial operations, etc.
- ° incorporation of a public education program to demonstrate the effect of noise on the community and means by which citizens themselves can reduce the annoyance of noise e.g. motorcycle driving habits, domestic activities
- ° development of a program to reduce noise from aircraft activity connected with the Industrial Airport.

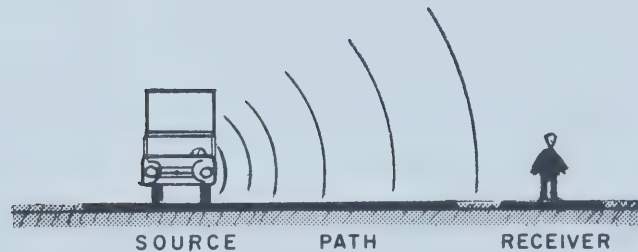
The survey has concluded that steps should be taken immediately to halt the continued development of unnecessary noise problems by: reassessment of zoning and building code requirements in the vicinity of major traffic routes; reassessment of noise levels permitted under local noise regulations with progressive improvement in the future; development of a program to reduce and isolate noise originating with heavy traffic routes and the Airport; and the initiation of a public education program to demonstrate how citizens themselves can reduce the noise problem.

CONTROL OF NOISE IN A CITY

Ever since mankind has been battling with pollution it seems that noise has been one of the most elusive contaminants. Possibly the reason for this is that noise straddles many disciplines and is rather difficult to isolate and contain.

Initial steps in the right direction have recently been taken in the form of legislation to abate, control and reduce noise. These pieces of legislation prescribe maximum permissible noise levels from surface motor vehicles, and inside and outside industrial plants. To halt the gradual increase of noise levels in our urban communities more attention will have to be paid not only to legislation and its enforcement, but to substantial changes in the public attitude toward noise generation and control.

Before noise control measures can be appreciated it is necessary to understand the mechanism of sound propagation. Consider the following diagram:



We are conscious of the presence of a noise at our ear by virtue of the vibrations at the source, and the ease or difficulty with which those vibrations cause pressure fluctuations to be transmitted through the air to our ears. If we want to receive less noise then it is necessary to modify the source, modify the path of transmission, or change the sensitivity of the receiver.

The latter alternative is out of the question unless we are prepared to condition ourselves to the constant wearing of ear muffs or plugs. The best approach, of course, is to change the source so that it generates less noise. The second best, and often most practical, is to change the nature of the path. How effectively the community as a whole can do this will determine the success or failure of our fight against noise "pollution".

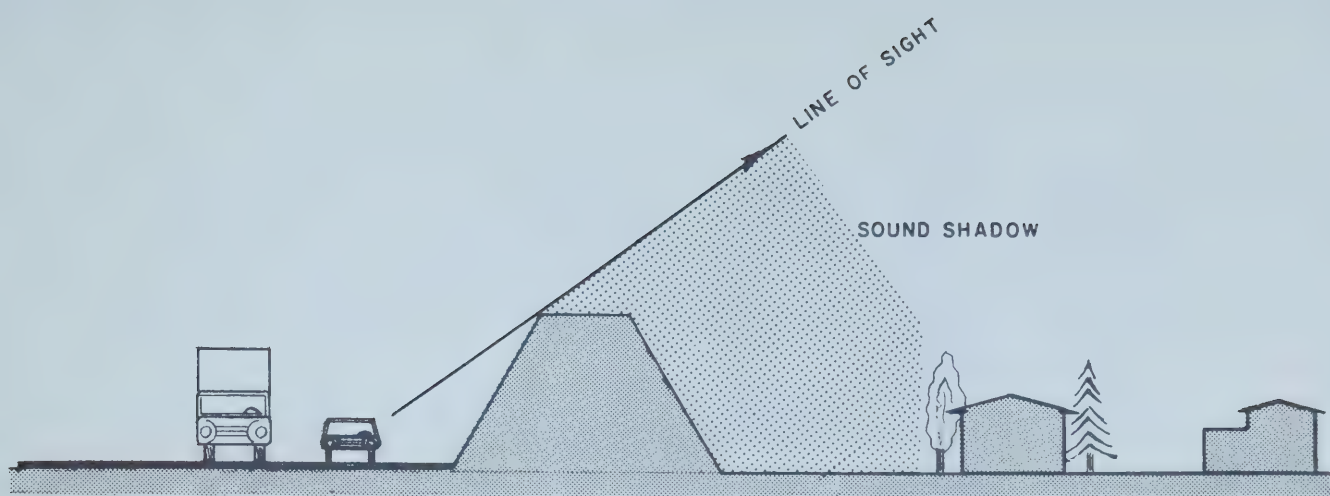
Technically, it is feasible to reduce almost all sources of noise to fairly low values, and it is certainly feasible to impose sufficient noise path barriers to reduce the sound reaching our ears to any desired value. What is most difficult is to achieve these results at a cost compatible with our ability to pay. As an example, large diesel trucks being sold today are normally capable of operating at less than 90dBA when used in the city on 30mph speed zones, and measured at an average distance of about 25 feet. Some older models have difficulty getting under 94 to 96dBA. It is possible to design a special unit that would operate at less than 75dBA, but the cost would be enormous, and the need for such a reduction is very debatable, except possibly for some special equipment meant to operate regularly in close proximity to residences.

The most practical approach, considering the need for retirement of existing equipment, will be to require that all vehicles meet gradually stiffer limits with the aim of perhaps 80dBA in ten years. Since these large units are one of the chief determinants of our "noise climate", such a reduction would significantly affect the overall level.

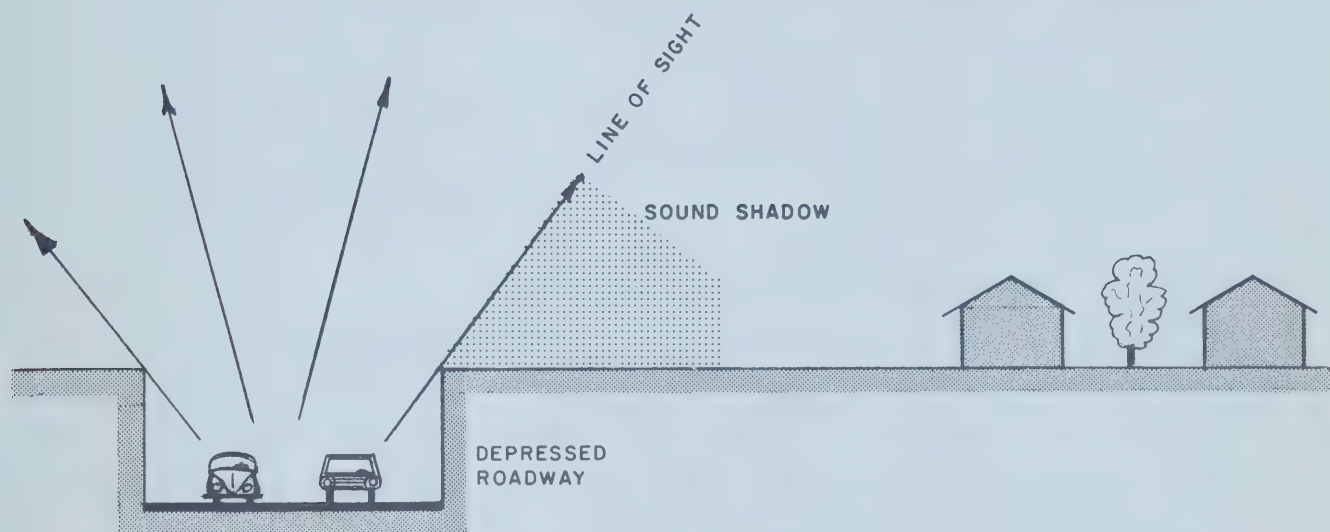
Other examples of noise control would involve decreases in traffic volume in sensitive areas, decreases in traffic speed in others, and the use of quieter mass transit vehicles to remove many vehicles from city streets.

In newly developing areas, and in redevelopment schemes, the most obvious need is to separate heavy traffic routes from residences by means of distance, sound barriers and berms, or depressed roadways. The various forms are illustrated in the accompanying sketches on Page 23.

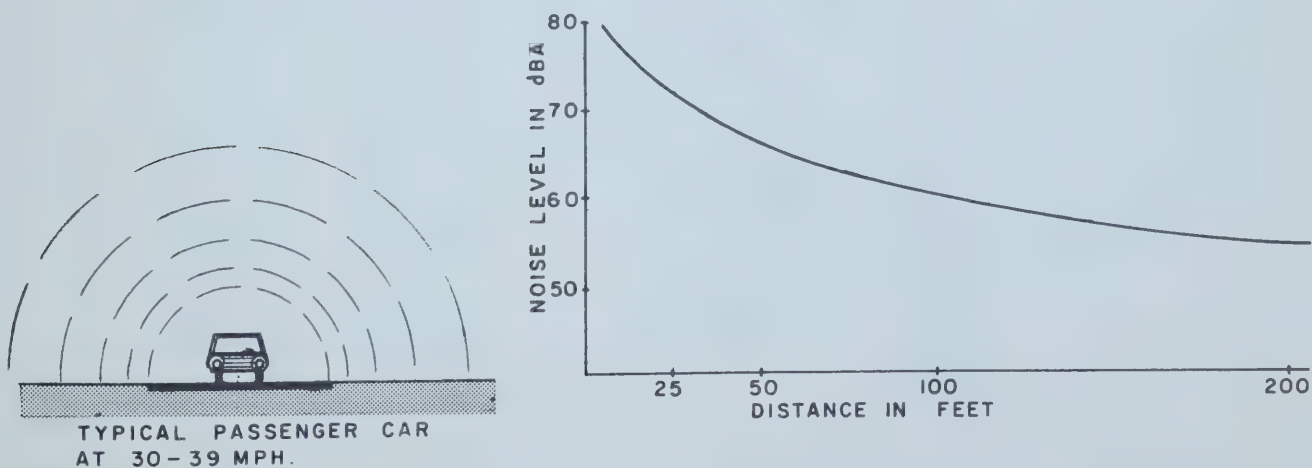
The sketches on Page 24 demonstrate how improvement in noise protection can be gained by use of park spaces and special construction of buildings along a traffic way.



EARTH BERM OR BARRIER TO REDUCE TRAFFIC NOISE



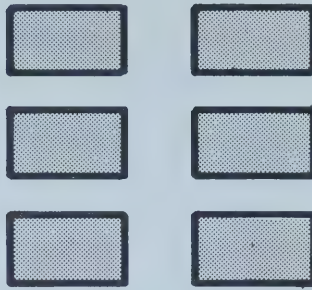
DEPRESSED ROADWAYS TO REDUCE TRAFFIC NOISE



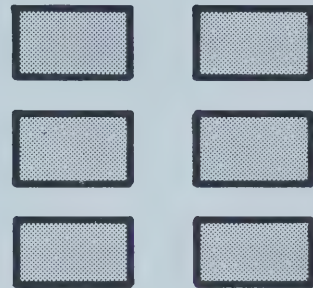
EFFECT OF DISTANCE ON NOISE

MAJOR
ROAD

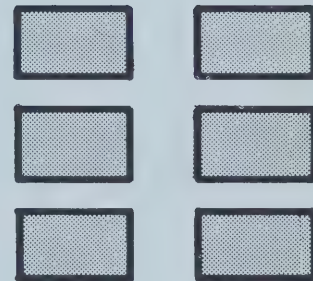
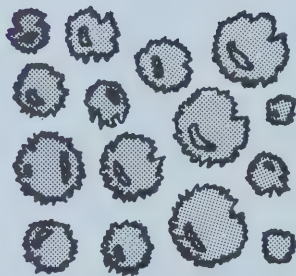
THERE IS EXCESSIVE
NOISE FOR RESIDENCES
NEAR A MAJOR ROAD.



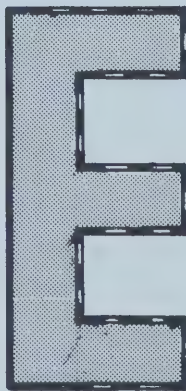
IT IS DESIRABLE TO
PROVIDE BUFFERING
IN THE FORM OF
PARKS, OPEN SPACES
AND GARDENS.



SLIGHTLY BETTER
BUFFERING CAN BE
ACHIEVED BY DENSE
TREE GROWTH.



APARTMENTS AND
OFFICE BUILDINGS
WITH WINDOWS FACING
AWAY FROM TRAFFIC
PROVIDE RELIEF FROM
NOISE FOR OCCUPANTS.
(RESIDENCES LYING IN
THE SOUND SHADOW
OF LARGE BUILDINGS
BENEFIT FROM THE
BUFFERING EFFECT.)



SIMPLE METHODS OF REDUCING TRAFFIC NOISE

In those areas where it appears impractical or uneconomic to achieve the necessary distance separation, then new buildings should be constructed to compensate for the noise exposure. Solid masonry or heavy walls without significant openings should face the noise source. Residential development along a roadway should create a solid barrier and face away from it.

There are many known solutions to the noise problem, applicable in a variety of ways. It requires a rational and an unemotional approach by an enlightened public to solve it.

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FIGURE 1A

TABLE OF RESIDENTIAL CELLS SELECTED FOR EDMONTON NOISE SURVEY

CELL	COMMUNITY NAME	AREA-ACRES	PEOPLE/ACRE	PEOPLE/CELL	VEHICLES/DAY ON PERIMETER	MATRIX ELEMENT	SAMPLED FOR NOISE	SAMPLED FOR SUBJECTIVE OPINION
Rc-38	King Edward	106	30.7	3,250	44,900	H H H	x	x
Rc-39	Richmond Park	73.7	18.3	1,350	51,100	M M H	x	x
Ra-11	Richmond Park	100	21.8	2,180	13,000	M M L	x	x
Rb-86	Avonmore	118	18	2,130	38,900	L M M	x	x
Rb-82	Idylwyld	63.4	17.5	1,100	52,200	L M H	x	x
Rb-72	Holyrood	43.6	16.1	700	33,200	L L M	x	x
Rc-34	Terrace Heights	61.8	20.9	1,290	31,200	M M M	x	x
Ra- 9	Fulton Place	96	18	1,730	16,300	L M L	x	x
Ra-10	Gold Bar	295	20.2	5,960	13,800	M H L	x	x
Rc-31	Rundle Heights	278	12.9	3,580	13,200	L H L	x	x
Rc-43	North Edmonton	51.2	40.4	2,070	21,400	H M L	x	x
Rc-28	Newton	365	15.7	5,720	31,000	L H M	x	x
Rc-32	Eastwood	19.2	20	380	22,000	M L L	x	x
Rb-93	Norwood	85.7	20	1,710	36,200	M M M	x	
Rc-23	Fairview	28.8	19	550	49,900	M L H	x	x
Rd-34	Queen's Avenue	22.4	40	900	41,200	H L M		x
Rd-20	McCauley-Queens Ave.	57.6	50	2,880	17,000	H H L	x	x
Rd-23	Gov't Centre	6.4	60	360	29,600	H L M		x
Rd- 3	Oliver	55.6	46	2,560	35,500	H H M	x	x
Rd- 2	Oliver	32	46	1,470	66,800	H M H		x
Rd- 1	Oliver	19.2	59	1,130	34,200	H M M	x	x
Rc-40	Rosslyn	96	13.8	1,330	29,600	L M M		x

FIGURE 1B

TABLE OF RESIDENTIAL CELLS SELECTED FOR EDMONTON NOISE SURVEY

CELL	COMMUNITY NAME	AREA-ACRES	PEOPLE/ACRE	PEOPLE/CELL	VEHICLES/DAY ON PERIMETER	MATRIX ELEMENT	SAMPLED FOR NOISE	SAMPLED FOR SUBJECTIVE OPINION
Rc-17	Calder Elm Park	288	20.5	5,900	35,800	M H M	x	x
Rb-97	Wellington	245	22.3	5,460	16,900	M H L	x	x
Rc-15	North Inglewood	43.2	21	910	39,800	M L M	x	x
Rb-49	Dovercourt	215	21.4	4,600	53,600	M H H	x	x
Rb-37	McQueen	160	18.4	2,950	60,300	M H H		x
Rb-33	South Glenora	77	9.2	710	51,900	L L H	x	x
Ra- 6	Crestwood	64	9.9	630	18,500	L L L	x	x
Rb106	North Jasper Place	175	14.6	2,560	53,500	L H H	x	x
Rd-49	North 156th Street	14.4	40	580	14,000	H L L		x
Ra- 3	Balmoral-Meadowlark P.154		11	1,700	10,000	L M L		x
Rd-46	149th Street	14.4	40	580	12,000	H L L	x	x
Rb-30	Jasper Park	259	16.2	4,180	39,300	L H M	x	x
Rb-13	S. Windsor Park	38.4	11.5	440	24,100	L L L		x
Rd-10	South Garneau	67	33	2,200	72,300	H M H	x	x
Rd- 9	Strathcona	67	50	3,350	56,000	H H H	x	
Rd- 7	Strathcona	21.2	30	600	65,200	H L H	x	x
Ra- 1	Greenfield	275	16	4,400	14,900	L H L	x	x

FIGURE 2A

24 HOUR AVERAGED dBA LEVELS IN LOCATIONS OF REPRESENTATIVE CELLS

CELL NO.	TEST NO.	1	1A	2	2A	3	4	5	5A	6	7	AVERAGE
Rc-38	L90	54		43		37	45					45
	L50	61		48		42	50					50
	L10	69		56		49	59					58
	L10-L90	15		13		12	14					13
Rc-39	L90	55	54 *	42		56						51*
	L50	62	60	47		59						56*
	L10	68	66	54		64						62*
	L10-L90	13	12	12		8						11*
Ra-11	L90	45		43		42						43
	L50	53		46		45						48
	L10	63		52		50						55
	L10-L90	18		9		8						12
Rb-86	L90	46	43	55	51	43	48					48*
	L50	52	50	61	58	47	55					54*
	L10	60	59	68	66	54	63					61*
	L10-L90	14	16	13	15	11	15					13*
Rb-82	L90	54	57	44	45	39						46*
	L50	62	64	51	50	43						52*
	L10	69	71	60	57	50						59*
	L10-L90	15	14	16	12	11						13*
Rb-72	L90	42		55		41	39					44
	L50	49		61		46	43					50
	L10	56		70		54	48					57
	L10-L90	14		15		13	9					13
Rc-34	L90	49		47		42	38					44
	L50	58		54		47	42					50
	L10	62		63		53	46					56
	L10-L90	13		16		11	8					12
Ra-9	L90	40		44	[Use Ra 10-1]	38						40
	L50	45		51	"	42						46
	L10	53		58	"	51						54
	L10-L90	13		14	"	13						14

FIGURE 2B

24 HOUR AVERAGED dBA LEVELS IN LOCATIONS OF REPRESENTATIVE CELLS

CELL NO.	TEST NO.	1	1A	2	2A	3	4	5	5A	6	7	AVERAGE
Ra-10	L90	39		40		39	46	41		38		41
	L50	45		45		43	50	44		42		45
	L10	55		51		53	55	48		49		52
	L10-L90	16		11		14	9	7		11		11
Rc-31	L90	40		36		42	38	48				41
	L50	45		40		46	43	55				46
	L10	54		47		52	50	64				53
	L10-L90	14		11		10	12	16				12
Rc-43	L90	46		35		46	36					41
	L50	53		39		52	39					46
	L10	60		46		61	45					53
	L10-L90	14		11		15	9					12
Rc-28	L90	59		34		49	40	39				44
	L50	66		38		55	44	47				50
	L10	74		47		62	49	57				59
	L10-L90	15		13		13	9	18				15
Rc-32	L90	46		51		47	41					46
	L50	51		57		54	44					52
	L10	57		65		64	49					59
	L10-L90	11		14		17	8					13
Rb-93	L90	44		44		39	37					41
	L50	51		53		46	42					48
	L10	59		62		54	50					56
	L10-L90	15		18		15	13					15
Rc-23	L90	55		54		42	40					48
	L50	61		60		47	46					54
	L10	70		68		53	55					62
	L10-L90	15		14		11	15					14

FIGURE 2C

24 HOUR AVERAGED dBA LEVELS IN LOCATIONS OF REPRESENTATIVE CELLS

CELL NO.	TEST NO.	1	1A	2	2A	3	4	5	5A	6	7	AVERAGE
Rd-20	L90	49		38		47	47	54				47
	L50	55		43		56	52	60				53
	L10	63		52		65	58	67				61
	L10-L90	14		14		18	11	13				14
Rd-3	L90	52		50		44	46	52				49
	L50	57		55		50	51	61				55
	L10	63		61		59	58	65				61
	L10-L90	11		11		15	12	13				12
Rd-1	L90	52		56		46						51
	L50	57		62		50						56
	L10	64		69		55						63
	L10-L90	12		13		9						12
Rc-17	L90	50		44		53	66	62		59	50	55
	L50	56		50		59	70	67		64	55	60
	L10	63		60		67	77	74		71	63	68
	L10-L90	13		16		14	11	12		12	13	13
Rb-97	L90	46		48		53	55	51				51
	L50	52		53		61	61	56				57
	L10	60		60		70	69	65				65
	L10-L90	14		12		17	14	14				14
Rc-15	L90	51		53		52	51	63				54
	L50	57		57		57	56	69				59
	L10	64		63		65	63	75				66
	L10-L90	13		10		13	12	12				12
Rb-49	L90	56		57		57	58	55	53			57*
	L50	62		62		62	63	58	59			61*
	L10	69		68		70	71	65	65			69*
	L10-L90	13		11		13	13	10	12			12*

FIGURE 2D

24 HOUR AVERAGED dBA LEVELS IN LOCATIONS OF REPRESENTATIVE CELLS

CELL NO.	TEST NO.	1	1A	2	2A	3	4	5	5A	6	7	AVERAGE
Rb-33	L90	54		52		48	52					52
	L50	61		59		51	55					57
	L10	68		66		56	60					63
	L10-L90	14		14		8	8					11
Ra-6	L90	48		49		55	47					50
	L50	52		53		60	51					54
	L10	56		59		66	56					59
	L10-L90	8		10		11	9					9
Rb-106	L90	50		52		55	56	47				52
	L50	55		59		62	64	51				58
	L10	62		67		71	72	58				66
	L10-L90	12		15		16	16	11				14
Rd-46	L90	56		53								55
	L50	63		59								61
	L10	72		67								70
	L10-L90	16		14								15
Rb-30	L90	49		54		56	52	52				53
	L50	53		59		62	58	56				58
	L10	58		64		69	65	63				64
	L10-L90	9		10		13	13	11				11
Rd-10	L90	55		55		49	56	53				54
	L50	61		60		53	61	59				59
	L10	68		65		61	68	65				65
	L10-L90	13		10		12	12	12				11
Rd-9	L90	51		44		51	46	47				48
	L50	55		47		55	49	52				52
	L10	62		55		61	57	61				59
	L10-L90	11		11		10	11	14				11

FIGURE 2E

24 HOUR ADVERTAGED dBA LEVELS IN LOCATIONS OF REPRESENTATIVE CELLS

CELL NO.	TEST NO.	1	1A	2	2A	3	4	5	5A	6	7	AVERAGE
Rd-7	L90	58		57		53	48	59				55
	L50	63		61		58	52	64				60
	L10	69		67		65	60	72				67
	L10-L90	11		10		12	12	13				12
Ra-1	L90	41		47		51	43	49				46
	L50	44		51		56	48	54				51
	L10	51		57		63	53	63				57
	L10-L90	10		10		12	10	14				11
Downtown 1	L90	58										
	L50	63										
	L10	70										
	L10-L90	12										
Downtown 2	L90	57										
	L50	61										
	L10	67										
	L10-L90	10										
Rural 1	L90	43										
	L50	46										
	L10	51										
	L10-L90	8										

* EXCLUDING WEEKEND AND MISCELLANEOUS MEASUREMENTS

TUESDAY, DEC. 5 - 1972

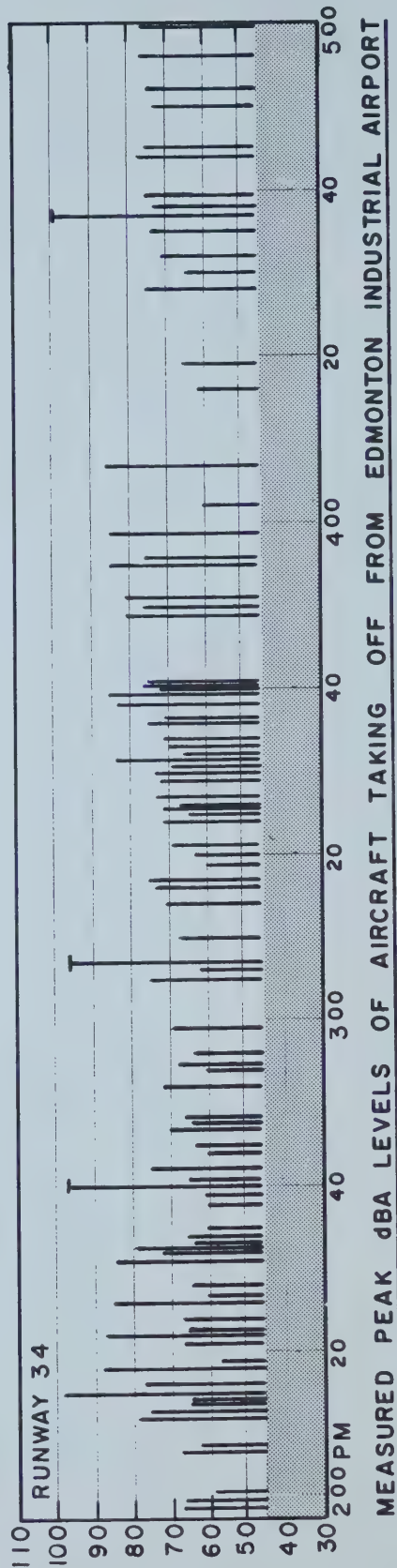
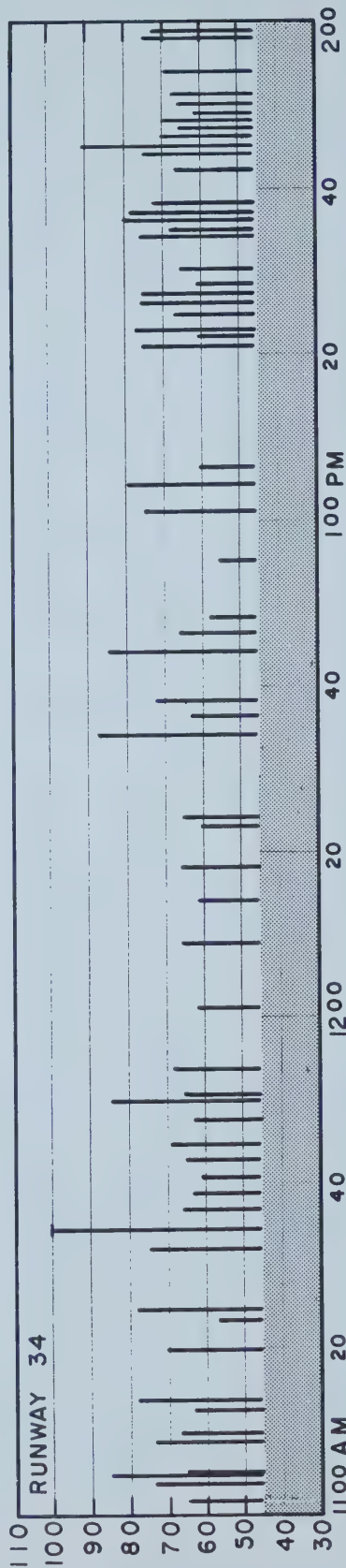
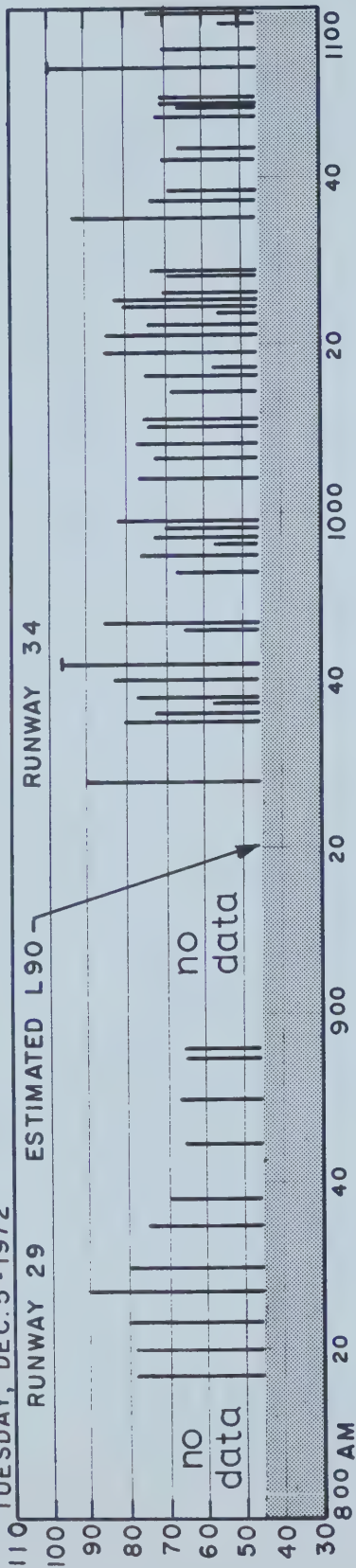
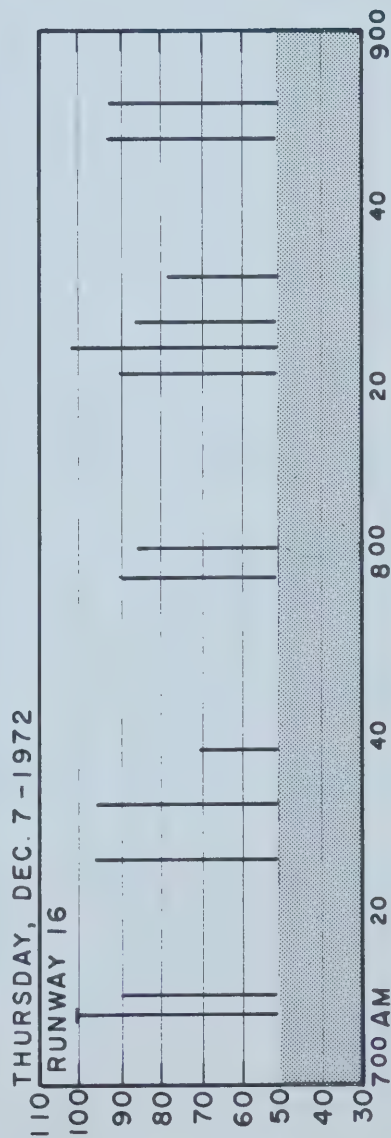
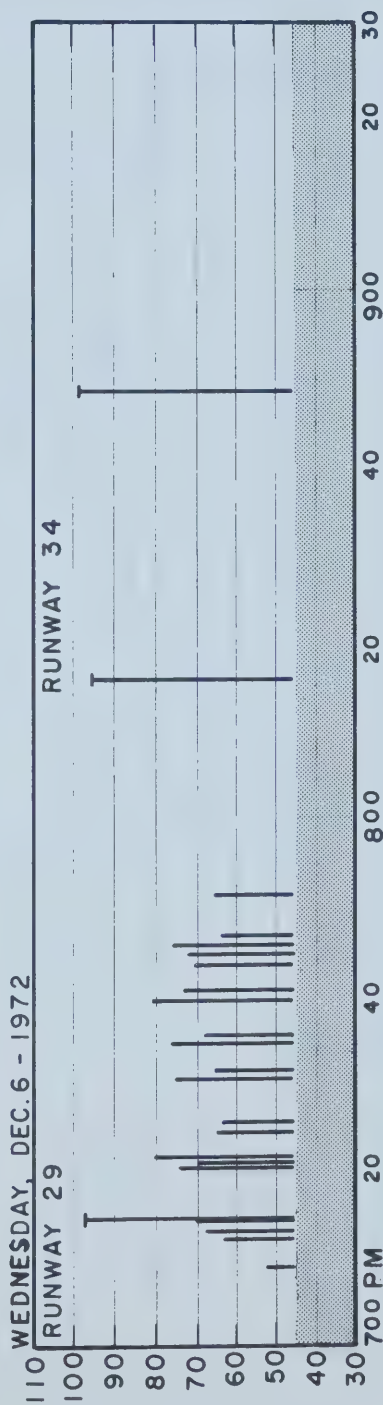
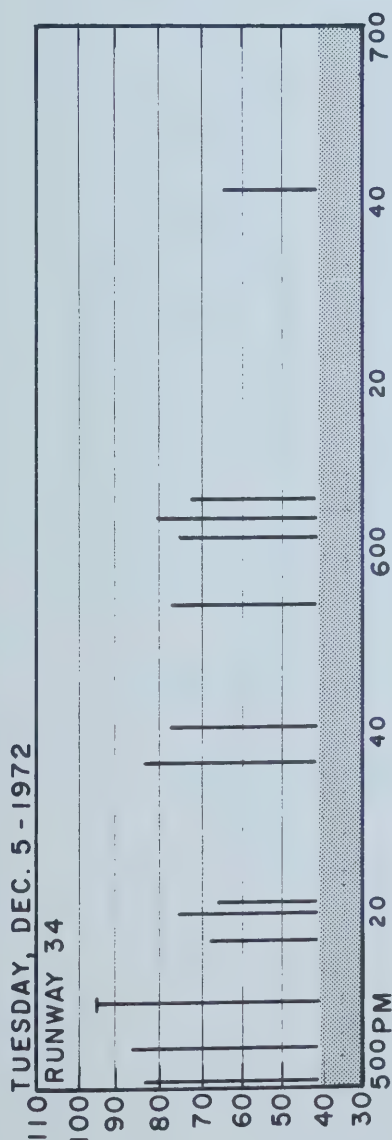
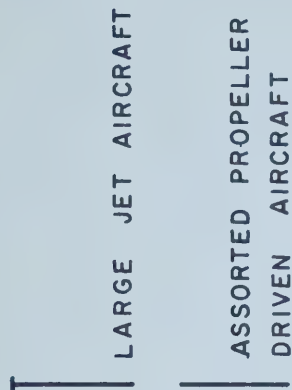


FIGURE 3A

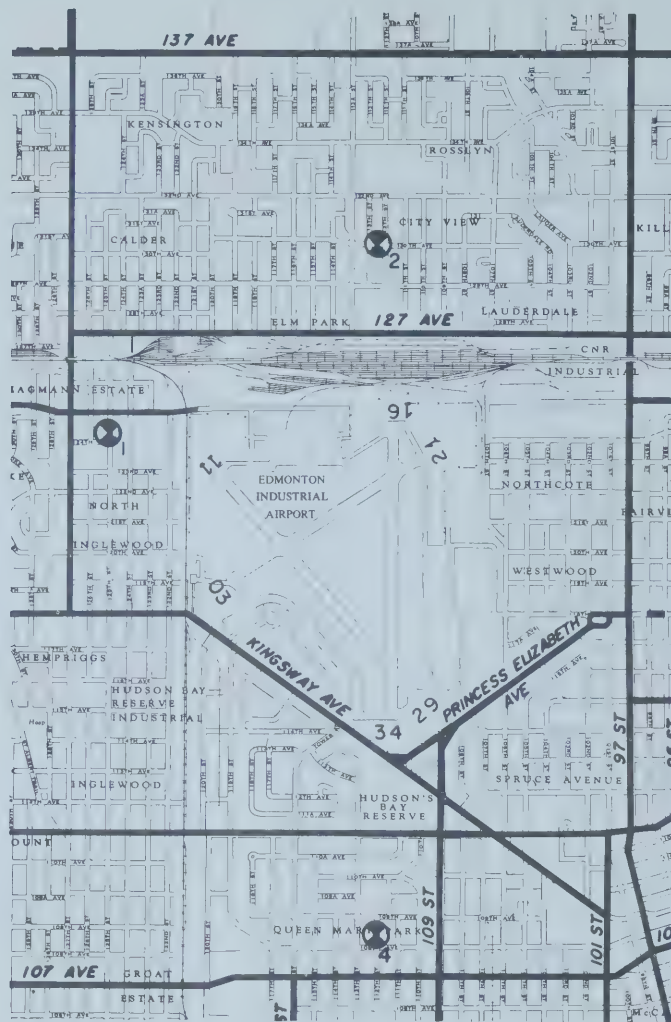
MEASURED PEAK dB LEVELS OF AIRCRAFT TAKING OFF FROM EDMONTON INDUSTRIAL AIRPORT

SYMBOLS



MEASURED PEAK dBA LEVELS OF AIRCRAFT TAKING OFF FROM EDMONTON INDUSTRIAL AIRPORT

FIGURE 3 B



NOISE MEASURING POSITIONS IN VICINITY OF EDMONTON INDUSTRIAL AIRPORT

- POSITION 1: 124th Avenue & 125th Street; 36' north of intersection of curbs; west side of street.
- POSITION 2: 130th Avenue & 113th Street; 36' east of intersection of curbs; north side of street.
- POSITION 3: 112th Avenue & 104th Street; 36' north of intersection of curbs; east side of street.(not used)
- POSITION 4: 108th Avenue & 112th Street; 36' north of intersection of curbs; west side of street.

EDMONTON NOISE SURVEY

INDUSTRIAL AIRPORT

FIG. 4

FIGURE 5A

SELECTED VARIABLES FROM COMMUNITY RESPONSE DATA

Area	Rated Living Conditions (1=Excellent) (5=Poor)	Most Disliked Feature	% Reporting That Feature	Most Frequent Noise Source	Mean Noisiness Rating (1=Noisy) (5=Quiet)	Mean Annoyance Rating (1=Annoying) (5=Not Annoying)
1. Rc-38	1.98	Traffic Noise Air Pollution	39	Traffic	3.47	3.80
2. Rc-39	2.25	Air Pollution	75	Traffic	3.25	3.90
3. Ra-11	1.95	Air Pollution	46	Traffic	4.01	4.20
4. Rb-86	1.88	Traffic Noise Air Pollution	*	Traffic	3.19	4.95
5. Rb-82	1.78	Traffic Noise Air Pollution	*	Not Quoted	3.65	4.30
6. Rb-72	1.66	Air Pollution	64	Traffic	3.38	4.48
7. Rc-34	1.92	Air Pollution Traffic Danger	47	Traffic	3.70	4.00
8. Ra-19	1.89	Air Pollution	73	Traffic	3.14	4.20
9. Ra-10	1.80	Air Pollution	72	Traffic	3.78	4.27
10. Rc-31	2.26	Air Pollution	84	Traffic	3.65	4.16
11. Rc-43	2.30	Air Pollution	79	Traffic	3.17	4.68
12. Rc-28	2.36	Air Pollution	75	Traffic	3.10	4.06
13. Rc-32	2.20	Traffic Noise	61	Traffic	3.52	4.54
15. Rc-23	2.22	Traffic Noise Aircraft Noise	61	Traffic	3.22	3.50
16. Rd-34	2.50	Traffic Noise Traffic Danger	*	Traffic	2.57	3.70
17. Rd-20	2.44	Traffic Noise	62	Traffic	3.04	4.22

FIGURE 5B

SELECTED VARIABLES FROM COMMUNITY RESPONSE DATA

Area	Rated Living Conditions (1=Excellent) (5=Poor)	Most Disliked Feature	% Reporting That Feature	Most Frequent Noise Source	Mean Noisiness Rating (1=Noisy) (5=Quiet)	Mean Annoyance Rating (1=Annoying) (5=Not Annoying)
18. Rd-23	2.00	Aircraft Noise Traffic Noise	*	Traffic	2.54	3.50
19. Rd- 3	1.93	Traffic Noise Aircraft Noise	*	Traffic	3.26	4.10
20. Rd- 2	2.06	Traffic Noise Aircraft Noise	*	Traffic	2.47	3.60
21. Rd- 1	1.95	Traffic Noise	81	Traffic	2.58	3.08
22. Rc-40	2.04	Aircraft Noise	75	Traffic & Aircraft	2.90	3.80
23. Rc-17	2.24	Aircraft Noise	78	Aircraft	2.92	4.01
24. Rb-97	2.08	Aircraft Noise	71	Aircraft	3.12	4.30
25. Rc-15	2.19	Aircraft Noise	75	Traffic	2.63	4.16
26. Rb-49	1.94	Traffic Noise	65	Traffic	3.08	3.82
28. Rb-37	1.89	Traffic Noise	59	Traffic	3.17	3.51
29. Rb-33	1.50	Traffic Noise	*	Traffic	3.56	4.02
30. Ra- 6	2.25	Traffic Noise	80	Traffic	3.62	4.14
31. Rb106	2.29	Traffic Noise	60	Traffic	3.07	3.58
32. Rd-49	2.47	Traffic Noise	86	Traffic	2.39	4.10
33. Ra- 3	1.65	Traffic Noise	31	Traffic	3.75	4.50
34. Rd-46	2.42	Traffic Noise	85	Traffic	1.84	3.60
35. Rb-30	2.19	Traffic Noise	44	Traffic	3.23	3.91
36. Rb-13	1.41	Aircraft Noise Traffic Noise	*	Traffic	3.25	3.98

FIGURE 5C

SELECTED VARIABLES FROM COMMUNITY RESPONSE DATA

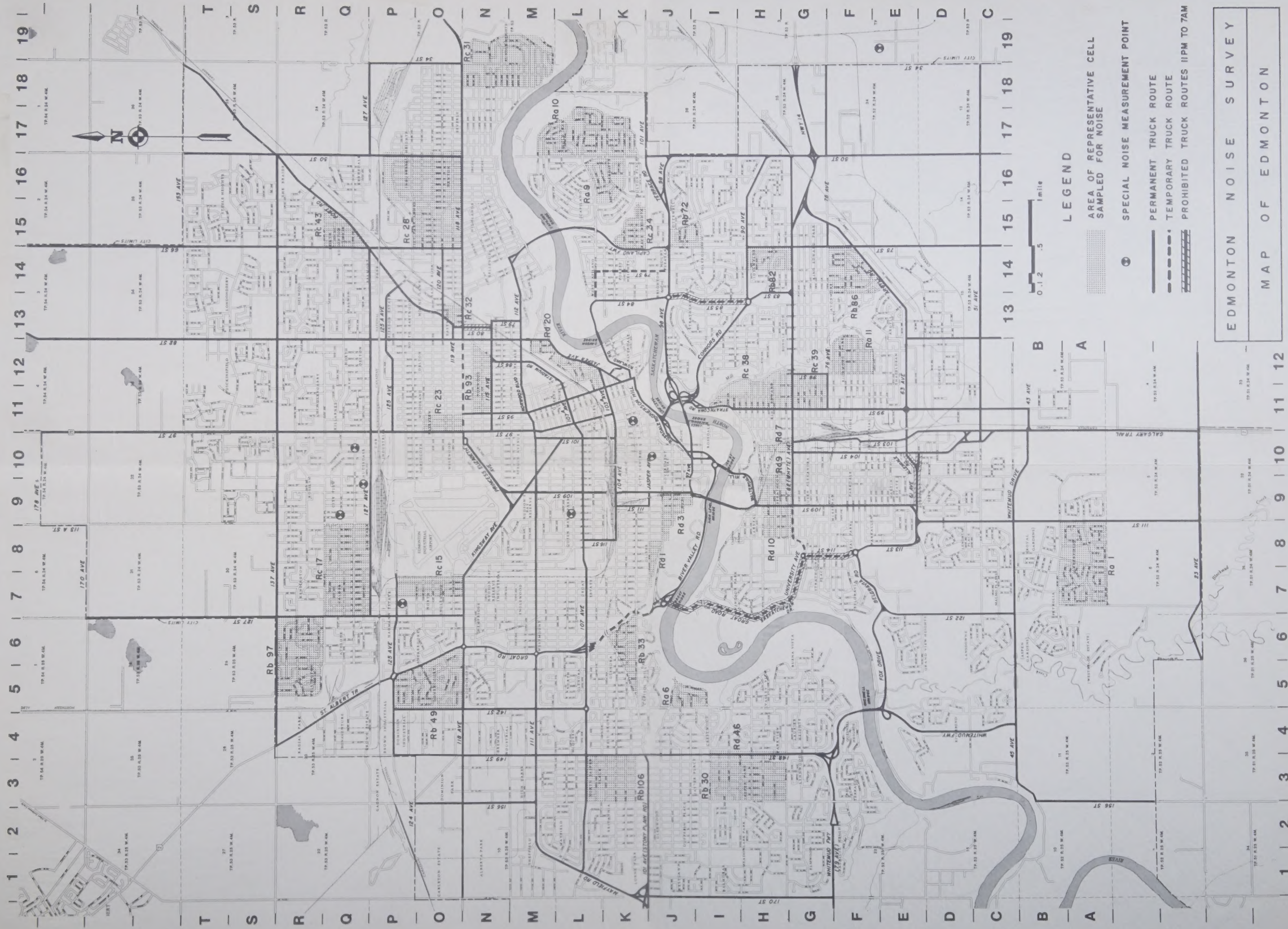
Area	Rated Living Conditions (1=Excellent) (5=Poor)	Most Disliked Feature	% Reporting That Feature	Most Frequent Noise Source	Mean Noisiness Rating (1=Noisy) (5=Quiet)	Mean Annoyance Rating (1=Annoying) (5=Not Annoying)
37. Rd-10	1.92	Aircraft Noise Traffic Noise	*	Traffic	2.93	4.04
39. Rd- 7	1.97	Traffic Noise	82	Traffic	2.28	4.13
40. Ra- 1	1.66	Not Indicated		Traffic & Children	3.74	4.02

* No clear majority reporting any single complaint



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EDMONTON NOISE SURVEY
MAP OF EDMONTON

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